Horizontal Technology Insertion
for On-Vehicle Diagnostics System

Military vehicles have a wide range of on-vehicle diagnostic capabilities. Older vehicles have essentially no on-vehicle fault isolation. The vehicle electronics, or Line Replaceable Units (LRUs), are diagnosed as faulty using symptom-based technical manual procedures. The test equipment used to make measurements consists of a large number of interface boxes, cables, and adapters. This equipment and the supporting manuals must be carried to the vehicle under test. The procedures are labor intensive, error prone, and time consuming.

Newer vehicles, such as the Bradley A3, have a system Mil-Std-1553 data bus that is used for System Functional Control and Run-Time Built-In-Test (BIT). In order to meet the primary mission of the vehicle, the BIT capabilities are often reduced to allow more vehicle functional control bandwidth. The remaining functional BIT provides fault isolation to an ambiguity group, and additional carry-on test equipment must be used to break the ambiguity and fault isolate to a single LRU.

In both of the cases described above, the fault isolation testing must be performed in a non-operational, maintenance mode. All of the test equipment must be carried to the vehicle, and testing involves removing the operational cables and connecting the test set cables and adapters to the LRUs. The process of manually inserting various off-board adapters, cables and test equipment is often a source of error itself, which adds to the complexity of the diagnostics process.

The PEI Sidecar™ System provides a comprehensive on-vehicle diagnostics solution. The Sidecar System consists of Sidecar Modules, Sidecar cables, a Host Controller, a Sidecar power supply, and software. The Sidecar Modules provide a means of measuring the signals needed for fault-isolation testing using permanently-installed, on-vehicle test equipment. Thus the probability of inadvertently inserting additional faults with carry-on equipment is reduced greatly. The diagnostics host controller provides the command and control of the diagnostic system. The host controller may be either embedded, such as a processor card in a vehicle LRU, or carry-on, such as a ruggedized PC. The software performs the diagnostic logic unique to the particular vehicle. If the host controller is permanently installed into the vehicle, diagnostics can be performed immediately upon application of vehicle power and continue to provide 'behind the scenes' diagnostics without affecting the function or mission of the vehicle. The crew can get instant verification of operability of some basic mission critical vehicle functions. If an error is present in the system then a carry-on PC can provide full diagnostics and fault isolation and an IETM capability.

Sidecar Modules

The PEI Sidecar Module consists of miniaturized electronic measurement equipment that is permanently installed in a vehicle. The modules are small, easily fitting into the palm of your hand and thus can be installed in small unclaimed vehicle spaces that are out of the crew operating space.

The modules provide measurements on demand from the LRUs via a high-speed, fault tolerant serial data bus. The Sidecar Modules are non-intrusive. They neither stimulate the LRU in any way, nor do they draw LRU power. Power for the

Sidecar network is provided from an independent Sidecar power source. Consequently, a completely “dead LRU” is still diagnosed from a power independent Sidecar. Even newer vehicle LRUs with built in BIT do not have an independent diagnostics system.

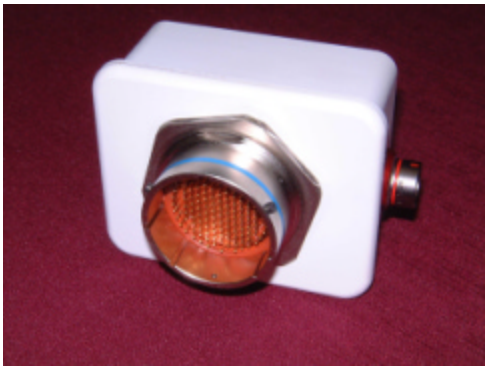
The Sidecar Modules are cabled together throughout the vehicle. The cables are militarized to withstand the vehicle’s operating environment and function as both a data bus and a power bus. The Sidecar Modules and cables are installed permanently in the vehicle thus minimizing the amount of carry-on maintenance equipment.

Sidecars mounted in the Abrams Tank.

The Sidecar measurements are digitized and sent to the Host Controller for diagnostics processing. Since all the Sidecars are networked together and the measurement results are sent to the host controller, the host controller can determine the state of the entire vehicle and thus provide diagnostics at a system level. With an on-board host controller, diagnostics are performed immediately upon vehicle power up and continue to provide ‘behind the scenes’ diagnostics without changing the function or mission of the vehicle. Sidecars provide diagnostics unobtrusively during vehicle missions. All of the Sidecar measurement data sent to the host controller and faults diagnosed by the host controller are logged into a large recursive memory buffer. The measurement data may be downloaded to a PC for mission analysis or prognostics. Depending on the activity of vehicle and amount of storage capability, the diagnostics memory buffer can log anywhere from 2 hours to 2 weeks worth of measurement data and fault information. In conjunction with the Host Controller, the Sidecar network can be used to provide complete vehicle diagnostics with maintainer interaction via an IETM.

There are two implementations of the Sidecar Module: external and embedded.

External Sidecar Modules



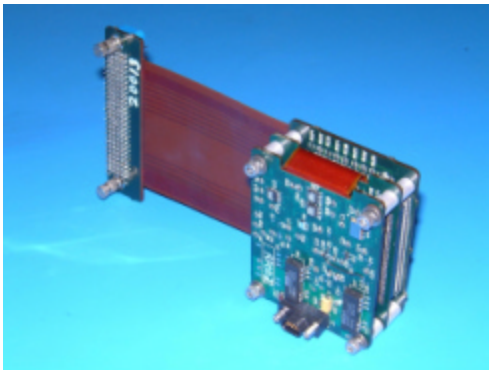
Sidecar Modules used with existing LRUs having test connectors are permanently installed in a vehicle. They are connected to the LRU's test connector via a “personality cable.” The personality cable connects the test connector signals to the Sidecar Module inputs with the appropriate electrical characteristics and gives the module its unique address in the diagnostic system. Since the personality cable provides the LRU unique routing to the Sidecar inputs, each Sidecar in the system is identical (one part number) and can be used interchangeably.

No LRU modification is required. The Sidecar Module receives its power via the Sidecar Cable. The diagnostic data is also transmitted to/from the Sidecar Module via the Sidecar Cable.

Since the Sidecar Module is a non-intrusive, high input impedance data acquisition unit, it can also be used at other available test points, such as a Diagnostic Connector Assembly (DCA), or may be 'T'ed in-line with a functional cable to achieve full fault isolation.

The Sidecar Module / personality cable combination has a significant logistics advantage. Each Sidecar Module is general purpose. The Sidecar Module's single part number reduces the number of spares required, yielding a significant logistics cost savings.

Embedded Sidecar Modules

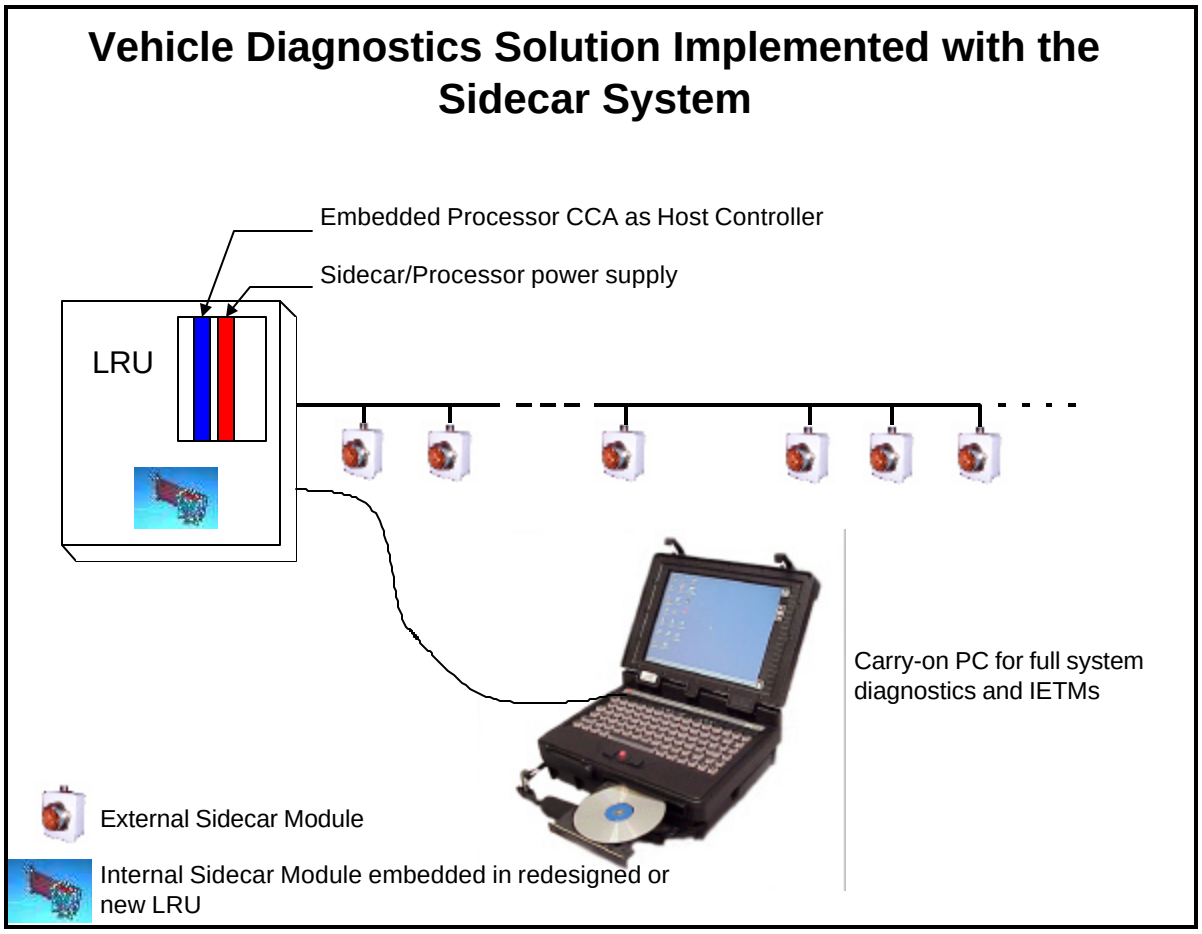


The Sidecar Module electronic circuitry can be incorporated into new LRU designs. This has an advantage of reducing the internal wiring requirements of a test connector. Only the Sidecar Cable connection needs to be brought external to the LRU. The Embedded Sidecar Module can be "dropped" into any new LRU design and seamlessly connect to a new or existing Sidecar network to provide system level diagnostics with the new LRU. This capability provides any Sidecar network equipped vehicle an easy, common LRU upgrade path for vehicle diagnostics.

Sidecar advantages:

- Non-intrusive data acquisition
- No LRU modification required
- Independently powered via the data/power bus
- High speed, fault tolerant serial data bus communications
- Does not require bandwidth from the vehicle functional data bus
- Provides independent monitoring of the system – measures signals at their source
- Easily adds a digital diagnostic solution to existing architectures
- Provides mission recording capabilities
- Environmentally sealed
- Rugged, high density construction

The Sidecar System offers an adjunct solution to any vehicle lacking in diagnostics capabilities. The single part number Sidecar Module and the vehicle specific personality cables provide for implementation to all vehicles. Solutions can range from full up embedded systems consisting of embedded Host Controllers providing run-time system health checks during vehicle operation to carry-on Host Controllers providing maintenance mode diagnostics.



PEI Electronics Inc. provides electrical, mechanical and software best-fit solutions for embedded diagnostics.

For more information regarding the Sidecar Module and Sidecar Diagnostic solutions please contact:

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